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PHILOSOPHICAL TRANSACTIONS.

Munday, June 3. 1667.

The Contents.

Experiments for Improving the Art of Gunnery; To find out the Point-blank distance; the Quantity of Powder, for the just Charge of any Peece; and what Gun shoots farthest. An Answer to some Magnetical Inquiries, formerly published in these Transactions. Extract of a Letter from Paris, containing an Account of some Effects of Blood Transfused, and of two Monstrous Births, &c. A Relation of two other Monsters, not long since produced in Devonshire. Some Observations made in Mines, and at Sea, occasioning a Conjecture about the Origine of Wind. An Account of a great number of Stones, found in one Bladder. The Description of a Well and Ground, in Lancashire, taking Fire by a Candle applyed to it. An Account of Athanasii Kircheri CHINA ILLUSTRATA.

Experiments for Improving the Art of Gunnery.

The better to determine the three Grand Desiderata, in the Art of Gunnery viz. 1. The Point-blank distance. 2. The Quantity of Powder for the just Charge of any Peece. 3. What Gun (for Size, Bore, Weight, Metal, &c.) Shoots Farthest: The following Experiments are proposed and directed, by Sr. Robert Moray; to give occasion to such as are Curious in this Art, to improve the same, as they shall have opportunity. Who we cannot but suppose will be so generous, as to impart the Successes and the Events of their Tryals of this kind to the Publisher of these Transactions; for further Improvement and Use.



O Know, how Far a Gun Shoots Point-blank (as they call it) that is, so near the Level of the Cylinder of the Peece, that the difference is either not discernable, or not considerable: On a fit plat-form, place and point the Gun at a Mark, as large as the Bullet, some 50. 60. or more Yards distant, so as the under-side of the Mark may be in the same Level or

Line with the under-side of the Cylinder of the Peece. Then, between the Gun and the Mark at several places, place pieces of Canvas, Sheets of Paper pasted together, or the like, upon Stakes fixt in the ground, so as the under-side, being level with the Horizon, may just touch the Visual line, that passeth from the Eye to the upper-side of the Mark; when the Eye is placed in the Line, that passeth from it to the upper-side of the Cylinder of the Gun; the Canvas being so broad and long, that, if the Bullet pass through it two or three foot higher than the Level of the Mark, or of either hand, the hole it makes, may make it known, how much it flieth higher than the Level of that place. Such piece of Canvas, &c. may be placed; *one*, at half the distance between the Gun and the Mark; *another*, half-way between the first, and the Mark, &c. And if it be found, that even at so small a distance the Bullet falls lower than the Mark, if it touch not the Canvas, the Gun may be next time raised a little, and so on, till the Bullet hit the Mark, or as high as it: And if at first it fall as high as the Mark and cut the Canvas, the Mark and Canvas may be brought neerer the Gun, till it needs be done no more: Afterwards the Mark may be removed to greater and greater distances, till, to hit the Mark, it fly higher, than some or all the interposed Canvasses: And thus the Experiment is to be repeated and varied at pleasure.

II. To know, what *Quantity* of Powder, is the *just* Charge of any Peece, so as it maketh the farthest Shot, and fires totally.

1. Raise the Gun to a *mean* Random, as of 20 or 25 degrees, and Shoot with the *ordinary* Charge of Powder, in some convenient ground, where the fall of the Bullet may be easily seen, and having made a Shot, measure the distance with a Chain, between the hole made by the Bullet, and the Muzzle of the Gun.

2. Then, instead of a full Charge of Powder used in the first Shot, take $\frac{1}{2}$ part lesse, or some such proportion, for the next tryal; doing all things else as before.

3. For a third, fourth, or more tryals, diminish still the Quantity of Powder by $\frac{1}{16}$ at a time, till the Shot be considerably Shorter, than at first.

4. Then take $\frac{1}{16}$ more than the first Charge, and do all things else as before, and so continue more tryals, increasing still the Quantity of Powder in the same proportion, every new tryal, till you find the increase of the Charge does not make the Peece
Shoot

Shoot further : Only over-Charge not so far, as to endanger the Gun.

5. The right Charge found, the best Random is to be sought by trying all Randoms, by degrees at a time.

To know, *What Gun Shoots farthest* ;

III.

1. A Gun, to be prepared of *Culverin-Bore* (as being held the best for Shooting far,) but much longer (double the Ordinary length may do well ;) is to be placed as in the former Experiments, and charged with the Ordinary Charge of a *Culverin*, or rather with that Quantity, which by the former Experiments shall be found the best ; and being Shot, the fall of the Bullet is to be markt, and distance measured, as hath been suggested.

2. Then try less, and more Powder in her, as before.

3. Then cut off two inches of the Muzzle with a Saw, and try as before, doing every thing in the same manner : And so cut off still for new tryals, till the Shot begin to fall shorter than before.

4. The same may be done with Guns of different Bores.

Advertisements.

1. The way to accommodate the Canvas, &c. proposed for I. finding out the *Point-blank-distance* ; is, *first* to pitch two stakes of the just height of the upper-side of the Cylinder of the Peece, some 6 or 8 foot asunder, in the streight line between it and the upper-side of the Mark, by a long Ruler, having one end in the Peece, after the Peece is duly point at the Mark ; and then, by the Eye looking over the Stakes to the upper-side of the Mark, or rather by a *Telescope*, the Paper or Canvas interposed may be let down, or placed just so, as the undermost-side may seem to touch the upper side of the Mark, to one that looks at it from the top of the first Stake.

2. If this way of Experiment be made for further distances and raisings of the Peece, as high as conveniently may be above the Level, and the distances measured as hath been intimated ; and then all Randoms above these likewise tryed and measured, the distance of an Object, to be Shot at, being known, and other necessary cautions, beneath to be mentioned, carefully observ'd, good Gunners may with great confidence undertake to hit the Mark, be the distance what it will, so it exceed not the reach of the Gun.

- II. 1. The Experiments here propos'd, are to be made in Guns of all *Sizes, Bores, Weights, Metals, &c.*
2. Three or more Shot to be made with every different Charge, and at every several tryal, that the certainty may the better appear.
3. The first Shot being Measured and marked, the rest may all be Measured from it, or from one another, to save labour.
4. The Gun is to be pointed, placed, and ordered every time in one and the same place and position, aiming still at the same Mark, or pointing still in the very same Line or *Azimuth*; that so all the Shot may fall in the same Line, as near as is possible.
5. The Powder must be *exactly* weigh'd, every time the Peece is charged, lest it having been weigh'd long before, the weight may be alter'd; though Experiment may be made with Cartridges and without.
6. The Powder and Bullet is to be rammed home *equally* at every Shot; though the looser the Powder lye, it fire the better.
7. When the *right* Charge of a Peece is found, that makes the farthest Shot in the ordinary and plain way of Charging, Monsieur de *Sons* contrivance of a *Wedge* may be tryed, to make it Shoot farther; which is a piece of Board, so long, as being thrust home to the Breech of the Peece at one end, the other may reach farther out than the outside of the Bullet, being ramm'd up to its place; broad about an Inch, and thin so far as the Wadd before the Bullet reaches on the out-side; *there* it is to have a Shoulder, from which forward to the end, it is to be cut a sloap like a *Wedge*, being of such thickness, as that at the place, where the Center of the Bullet is to be, it may make it stick so fast, that the Powder finding more resistance may at length drive it out with the greater violence.
8. Another of this nature is a Wooden *Tampion*, like a piece of a Cylinder, big enough to fill the hollow Cylinder of the Gun, the length somewhat more than the Diameter of it and hollow'd towards the Bullet, so as to fit it; and *either* flat, or (which is better) hollow likewise towards the Powder, and serving instead of a *Wadd*. These and such others will probably render the effect of the Powder greater, than otherwise it would be.
9. The *Strength* of the Powder must be examin'd by a *Powder-Tryer*, that raiseth a Weight, such an one as has been contrived by Mr. *Hook*, and is made by Mr. *Shortgrave*, Operator to the *Royal Society*.
10. The

10. The Powder used in a Set of these Experiments, ought to be all of the same goodnes.

11. The same Bullet is to be made use of, if it can be had, till the Figure of it be marred; otherwise another as near of the same Size, Shape, and Weight, as is possible.

12. The strength of the Wind, is to be observed at every time of Shooting; which may be done by an Engine, made by the lately nam'd *Operator*.

13. Observe also the Position of the Wind, with a Fane and Compass at every Shot.

14. Note also, at what *Azimuth* the Mark stands from the Gun.

15. Take precise notice, what effect the Wind hath every time upon the Bullet, in carrying further, in hindering, or turning it aside.

16. Note the Figure, dimensions, and Weight of the Gun, Carriage and Wheels.

17. The plat-form to be very Levell.

18. The Wheels to be at every Shot placed in the very same place and position, to avoid inequalities.

19. Every thing to be *exactly* recorded in a Book, as also every Accident and Observation.

20. After all other Experiments are made, every Peece may be tryed with the right Charge of Powder, laying every time more and more Weight upon the Carriage; and at last fixing the Gun so, as it may not recoyle at all, observing every time how far the Bullet goes, and how much less Powder than the full Charge will serve to Shoot the Bullet, when the Peece is fixt, as far as the whole Charge does, when it recoyls freely.

21. Care is to be had, that the Experiments with the *Wedge*, *Tampion*, and the like, made for encreasing the force of the Powder, and the fixing of the Peece, do not endanger it.

1. The Long Guns are to be made without any *Ring* about III. the Muzzle.

2. The pieces cut of from the Muzzle, to be alwayes laid on the Carriage, when new shots are made, or their weight of Lead in a convenient Figure, that the recoyl may still be the same.

3. The Quantity of Powder, that Shoots furthest in an *Ordinary Culverin* being known, there needs no Variation of it in the Long one.